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Quality of Western Canadian malting barley 2015

Annual Harvest Report

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Summary

Total barley production in Western Canada in 2015 is estimated at 7,786,000 tonnes, which represents an increase of about 16% compared with 2014. The larger crop is attributed to a 12% increase in seeded acres in 2015 compared with 2014.

Seeding started relatively early this year with dry and warm conditions in early spring. The growing season was characterized by average to above average mean temperatures and below average precipitation through late July, particularly in Alberta and western Saskatchewan. However, excess precipitation in August and September resulted in sprouting and weather damage, downgrading large portions of the crop and limiting the quantity of barley selectable for malting purposes.

The 2015 barley harvest survey conducted by the Grain Research Laboratory and the Canadian Malting Barley Technical Centre was based on composites of individual varieties representing 1,112,000 tonnes of barley selected in Western Canada for malting by grain handling and malting companies.

Overall, malting barley selected in 2015 was of average quality. Thousand kernel weights and kernel plumpness levels were higher than the long term averages. Protein levels in barley grain were higher than levels in 2014. Barley germination was adequate; however, some water sensitivity was present. RVA (rapid visco analysis) indicated high incidence of pre-harvest sprouting.

Malt made from 2015 barley resulted in extract levels very close to the long term average values and with above average levels of enzyme activities. Wort was characterized by very low levels of β-glucans, but higher than average levels of soluble proteins, FAN (free amino nitrogen), and colour. Production of good quality malt from the 2015 barley crop may pose some challenges but is achievable through discerning barley selection and timely and skillful processing.

Part 1- Growing and Harvesting Conditions in 2015

The soil moisture situation during the fall of 2014 was mixed in the main barley growing areas of Western Canada as excellent subsoil moisture supplies in central and eastern Saskatchewan were counterbalanced by dry conditions in Alberta. Snowfall during the winter was above normal in the northern growing areas, but southern regions were mostly dry. Warmer than normal temperatures and dry conditions during April and May resulted in rapid planting progress (Figures 1.1 and 1.2). These dry conditions and early seeding activities were a stark contrast to a wet spring and late seeding that occurred in 2014. Nearly half of the barley was planted by May 15th and most of the crop was planted by the end of May. A severe frost in the northern growing areas of the Prairies caused damage to emerged barley plants and some areas needed to reseed a portion of their planted area.

The dry, hot weather continued through the month of June and the first half of July in the western Prairies, which caused stress to barley crops in western Saskatchewan and Alberta. The hot and dry weather that prevailed through the first half of the growing season helped crops to develop, but also contributed to higher protein levels. The hot and dry conditions resulted in considerable crop stress and loss of yield in Alberta and western Saskatchewan. Conversely, eastern growing areas of Saskatchewan and Manitoba received timely rainfall and had minimal stress. These regions reported average to above average yields, although protein levels were still above last year.

Harvest started relatively early due to early seeding and hot growing conditions and approximately 40% of the barley crop was harvested by the end of August. Rainfall during late August and September in the central and northern barley growing areas slowed harvest and affected the quality of remaining barley harvest. Harvest progressed slowly during September and October and finally reached completion during the first week of November. The quality of the barley harvest in October was severely compromised by the wet weather conditions.

Figure 1.1 Mean temperature difference from normal for April 2015

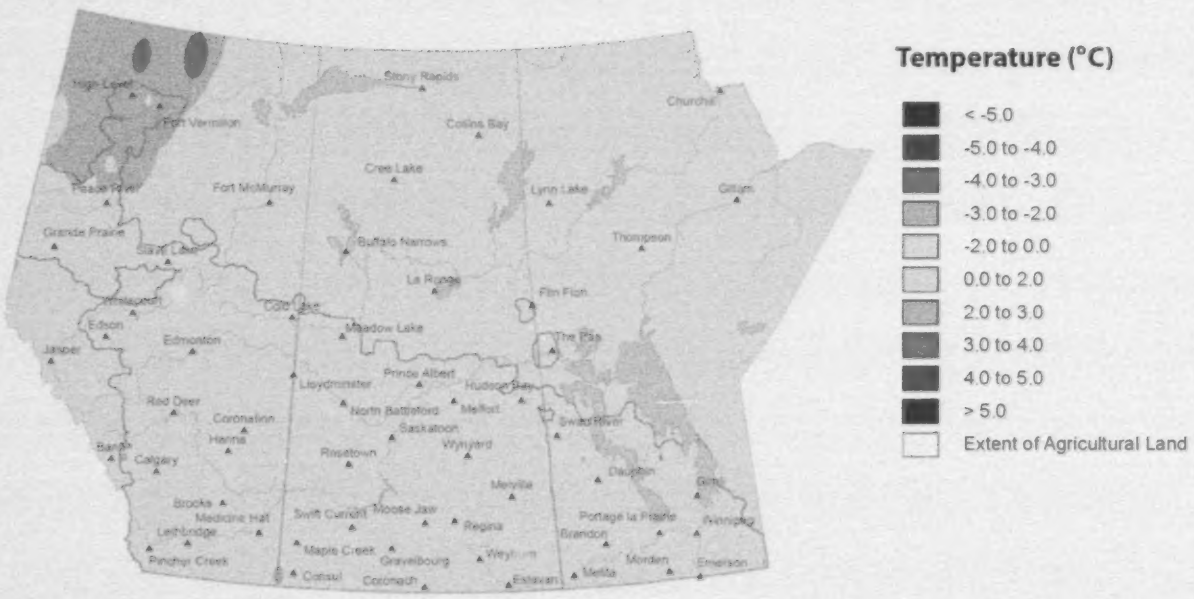

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Figure 1.2 Percent of monthly average precipitation April 26, 2015 to May 25, 2015

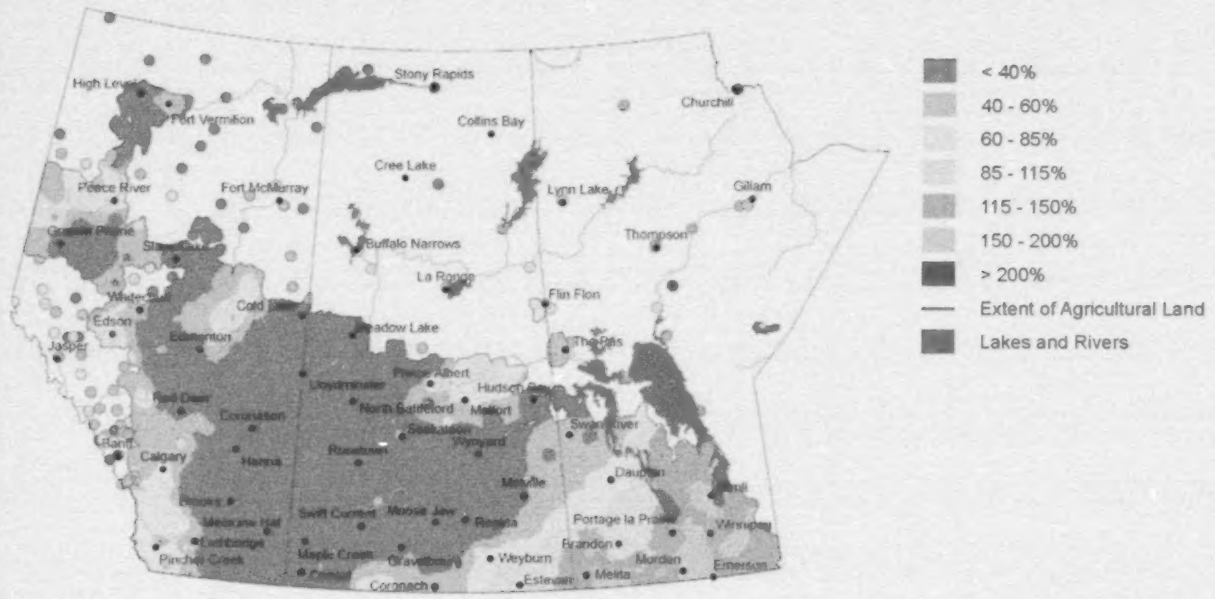

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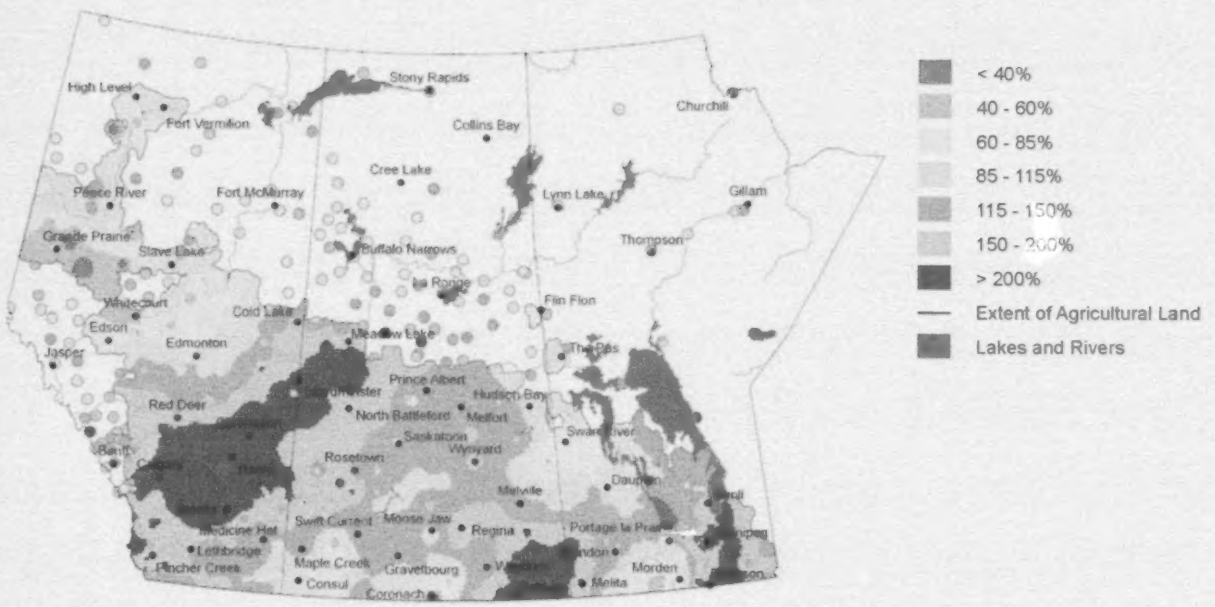
Figure 1.3 Percent of monthly average precipitation August 9, 2015 to September 7, 2015



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Part 2 - Barley Production in 2015

The total area planted with barley in Western Canada in 2015 was 2.513 million hectares, a 12% increase over the 2014 acreage (Table 2.1). Total barley production in Western Canada in 2015 is estimated at 7.8 million tonnes, which represents an increase of 16% compared with 2014 (Table 2.1). Barley production in Manitoba and in Saskatchewan increased by 59% and 32%, respectively, compared with last year. Alberta, despite a 5% increase in seeded acreage, had only a 4% increase in production in 2015 compared with last year. This was likely caused by loss of seeded crop due to drought conditions in some areas. Figure 2.1 shows annual barley seeded acreage and production in Western Canada since 2005. Both barley seeded area and barley production in 2015 were down about 20% and 12%, respectively, from the 10-year average (2005-2014). Average barley yield in 2015 is estimated at 65 bushels per acre, slightly higher than in 2014 (62 bushels per acre) (Statistics Canada, CANSIM Table 001-0017).

Table 2.1 Comparison of barley production in Western Canada for 2015 and 2014 with the ten year average production[1]

	Seeded area (million hectares)			Production (million tonnes)		
	2015	2014	2005-2014 average	2015	2014	2005-2014 average
Manitoba	0.162	0.121	0.258	0.566	0.355	0.744
Saskatchewan	0.971	0.809	1.276	2.863	2.172	3.360
Alberta & British Columbia	1.380	1.317	1.622	4.357	4.174	4.778
Western Canada	2.513	2.248	3.157	7.786	6.702	8.881

[1] Statistics Canada, *CANSIM TABLE 001-0010*, accessed December 4, 2015

Barley is a multi-purpose crop grown for malting, general purpose (feed and forage) and food in a widespread area across the Canadian Prairies. This year in Alberta (and parts of British Columbia), general purpose barley accounted for 58.5% of total barley seeded area compared with malting barley at 40.9% (Fig. 2.2). In Saskatchewan, the majority of seeded area (71.5%) was planted with malting barley varieties (Fig. 2.2). In Manitoba, about 48.1% of barley seeded area was allocated to malting varieties and 50.2% to general purpose (Fig. 2.2). Overall

Figure 2.1 Barley production and barley seeded area in Western Canada from 2005 to 2015

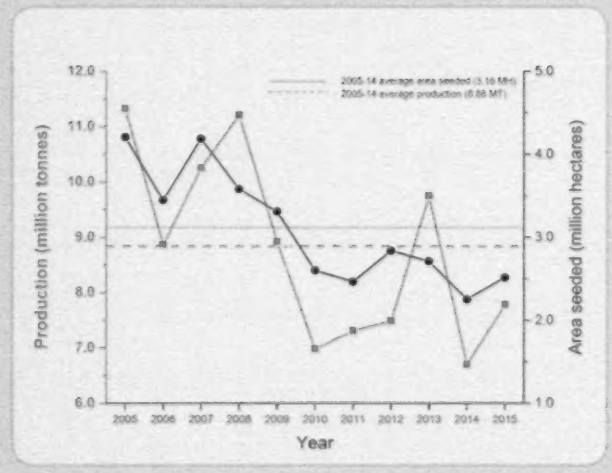
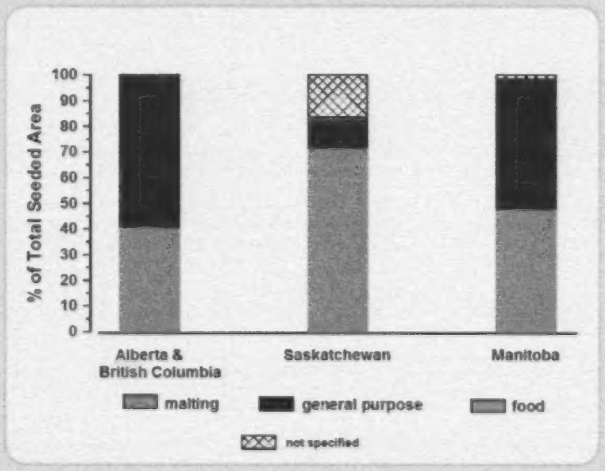


Figure 2.2 Distributions of barley classes as a percentage of total area seeded with barley in Western Canada provinces in 2015



malting barley accounted for 53.1% of barley seeded area in Western Canada compared with general purpose barley at 40.0%. Food barley continued to occupy a relatively small percentage of seeded acres in each province.

In recent years, a relatively small number of varieties has dominated the portfolio of malting barley cultivars being grown and selected in Western Canada. This year AC Metcalfe and CDC Copeland remained the most popular malting varieties representing about 74% of total acres seeded with malting barley (Table 2.2). In comparison to last year, the acreage seeded with AC Metcalfe in 2015 remained almost unchanged, whereas the acreage allocated to CDC Copeland increased by 5.6% (Table 2.2). The area seeded with CDC Meredith decreased from 9.8% in 2014 to 5.2% in 2015. The acreage planted with several newer two-rowed cultivars, such as Bentley, CDC Kindersley, AAC Synergy, and Merit 57, increased somewhat compared to last year but still remained relatively low compared to the area seeded with AC Metcalfe and CDC Copeland (Table 2.2). The production of six-rowed malting barley continued to decline. In 2015, the six-rowed cultivars occupied only about 6.5% of the total area seeded with malting barley. Legacy, Celebration and Tradition remained the top three six-rowed varieties (Table 2.2). Table 2.3 shows the distribution of malting barley cultivars as percentage of acreage seeded with malting barley in each province. The production of two-rowed cultivars dominated in Alberta and Saskatchewan with CDC Copeland occupying the largest area in Alberta and AC Metcalfe in Saskatchewan. Newdale and AC Metcalfe prevailed among the two-rowed varieties seeded in Manitoba, but a relatively large portion of land in Manitoba was also seeded with six-rowed varieties, especially Celebration and Tradition (Table 2.3).

The Canadian Malting Barley Technical Centre (CMBTC) in collaboration with its member organizations and other industry groups produces an annual Recommended Malting Barley Varieties List which is intended as a guide to assist producers in the selection of varieties for seeding in the coming year (Table 2.4)

Table 2.2 Distribution of malting barley cultivars as percentage of acreage seeded with malting barley in Western Canada[1]

Two-rowed cultivars (% of acreage seeded with malting barley in Western Canada)		
	2015	2014
AC Metcalfe	38.5	38.9
CDC Copeland	35.4	29.8
CDC Meredith	5.2	9.8
Newdale	5.2	5.7
Bentley	3.4	2.4
CDC Kindersley	1.7	0.9
CDC PolarStar	1.4	2.0
AAC Synergy	0.8	0.2
Merit 57	0.7	0.6
Major	0.4	0.8
Harrington	0.2	0.3
CDC Kendall	0.2	0.2
Other	0.4	0.1
Total	93.5	91.6

Six-rowed cultivars (% of acreage seeded with malting barley in Western Canada)		
	2015	2014
Legacy	3.3	4.4
Celebration	1.3	1.1
Tradition	0.9	1.3
CDC Yorkton	0.2	0.3
Robust	0.2	0.2
Stellar-ND	0.2	0.5
Lacey	0.1	0.3
CDC Battleford	0.1	0.1
Excel	0.1	0.1
Other	0.1	0.1
Total	6.5	8.3

[1] Data Source: Sask Crop Insurance, Alberta Ag Financial Services Corp, Manitoba Management Plus Program, BC Crop Insurance

Table 2.3 Distribution of malting barley cultivars as percentage of acreage seeded with malting barley in each province in 2015[1]

Two-rowed cultivars (% of acreage seeded with malting barley in Western Canada)			
	AB & BC	SK	MB
AC Metcalfe	32.4	46.0	15.5
CDC Copeland	42.4	32.5	8.4
CDC Meredith	5.9	4.9	3.1
Newdale	4.6	3.8	22.9
Bentley	5.7	1.0	7.8
CDC Kindersley	3.0	0.7	0.9
CDC PolarStar	0.2	2.6	0
AAC Synergy	1.4	0.4	0
Merit 57	1.6	0	0
Major	0.4	0.5	0
Merit	0.6	0	0
Harrington	0.2	0.1	0
CDC Kendall	0.2	0.1	0
Other	0.3	0.1	0.1
Total	98.9	92.7	58.7

Six-rowed cultivars (% of acreage seeded with malting barley in Western Canada)			
	AB &BC	SK	MB
Legacy	0.3	5.8	2.4
Celebration	0	0.4	19.6
Tradition	0	0.5	11.6
CDC Yorkton	0.2	0.1	1.5
Robust	0	0.1	2.0
Stellar-ND	0	0.1	1.8
Lacey	0.1	0	1.9
CDC Battleford	0.3	0	0.1
Excel	0	0.2	0.2
Other	0.1	0.1	0.1
Total	1.0	7.3	41.2

[1] Data Source: Sask Crop Insurance, Alberta Ag Financial Services Corp, Manitoba Management Plus Program, BC Crop Insurance

Table 2.4 Malting barley cultivars recommended for production in Western Canada in 2016-2017 (CMBTC)

Two-Rowed Varieties		
Varieties	Market comments	
CDC Copeland[1]	Established Demand	Some two-rowed varieties are exclusively handled by one or a limited number of companies. As a result it is recommended that producers consult with their grain company representative, local elevator operators or malting companies regarding commercial opportunities for specific varieties. For Bentley contracting opportunities contact Canada Malting Company. For CDC PolarStar contracting opportunities contact Prairie Malt-Cargill. For Newdale contracting opportunities contact Canada Malting Company or North American Food Ingredients. For Merit 57 contracting opportunities contact BARI-Canada.
AC Metcalfe[1]	Established Demand	
Bentley[2]	Limited Demand	
CDC Meredith[1]	Limited Demand	
CDC PolarStar[2]	Limited Demand	
Newdale[4]	Limited Demand	
Merit 57[2]	Limited Demand	
CDC Kindersley[1]	Under Commercial Market Development - Growing Demand	
AAC Synergy[5]	Under Commercial Market Development - Growing Demand	
Six-Rowed Varieties		
Varieties	Market comments	Demand for six-rowed malting barley has been declining and it is recommended that producers consult with their grain company representative, local elevator operators or malting companies regarding commercial opportunities for specific varieties.
Legacy[3,4]	Limited Demand	
Tradition[4]	Limited Demand	
Celebration[2]	Limited Demand	

[1] SeCan [2] CANTERRA SEEDS [3] Crop Production Services [4] FP Genetics [5] Syngenta

Part 3 - Annual Harvest Survey

3.1 Sampling and survey methodology

The 2015 malting barley survey was based on 62 varietal composites, representing a total of 1,112,000 tonnes of barley selected for domestic malt processing or for export as malting barley by several grain handling and malting companies: Cargill Inc, Canada Malting Co. Ltd., Rahr Malting Co., Richardson International, Viterra Inc., Malteurop North America Inc. The tonnage included in this survey represents only a portion of the total volume of malting barley selected in Western Canada and does not necessarily reflect the actual amounts selected. Samples were received from the beginning of harvest until the 5th of November, 2015. All results presented in this report represent weighted averages based on tonnage of composite samples received and analyzed.

3.2 Quality of barley selected for malting in 2015: general trends and annual statistics

Malting barley selected in 2015 was of average quality overall. The levels of barley proteins in 2015 (12.4%) were higher than in 2014 (11.7%) and higher than the 10-year average (11.7%) (Figure 3.1). Germination energy of barley samples determined during the annual survey was adequate for malting (Figure 3.2); however moderate water sensitivity was present in some samples. This year's barley had very high average 1000 kernel weight (45.7g), higher than in 2014 (44.2g) and higher than the 10-year average (43.2g) (Figure 3.3). Kernel plumpness, a measure of kernels remaining on the 6/64" slotted screen, averaged 94.5% which is considerably higher than the 10-year average (91.2%) (Figure 3.4). The average kernel diameter and kernel weight were also determined using the Single Kernel Characterization System. The results, presented in Figure 3.5, indicated differences among barley varieties with Bentley, CDC Meredith, and AAC Synergy having bigger and heavier kernels than other varieties.

Figure 3.1 Average protein content in barley selected for malting from 2005-2015

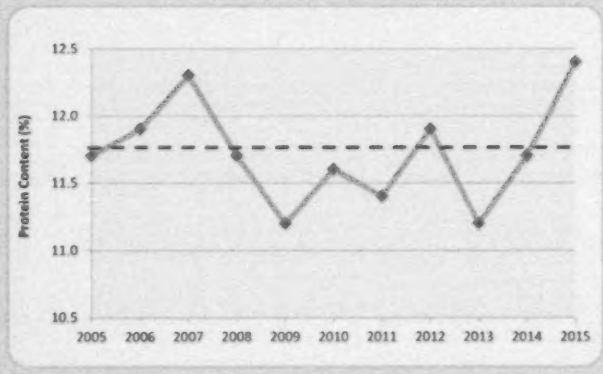
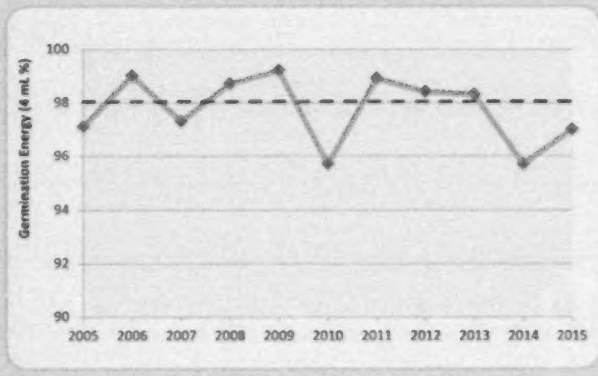


Figure 3.2 Average germination energy of malting barley selected from 2005 to 2015



Pre-germination is the premature sprouting of grain while still in the ear as a consequence of prolonged spells of wet weather when mature grain remains uncut in the field; this event is called 'pre-harvest sprouting'. One of the enzymes produced very early during germination is α-amylase. Since the level of α-amylase in sound grain is very low compared to its level in the germinating grain, the content of α-amylase in grain can be used as a marker of germination. Rapid visco analysis (RVA) indirectly estimates the amount of α-amylase in barley by measuring the viscosity of ground barley in water.

Figure 3.3 Average 1000 kernel weight of barley selected for malting from 2005 to 2015

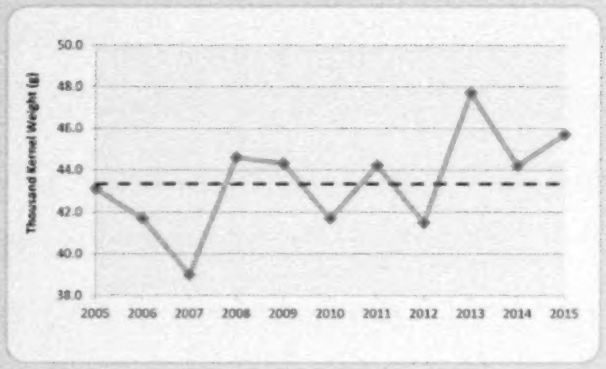


Figure 3.4 Average plumpness of barley selected for malting from 2005 to 2015

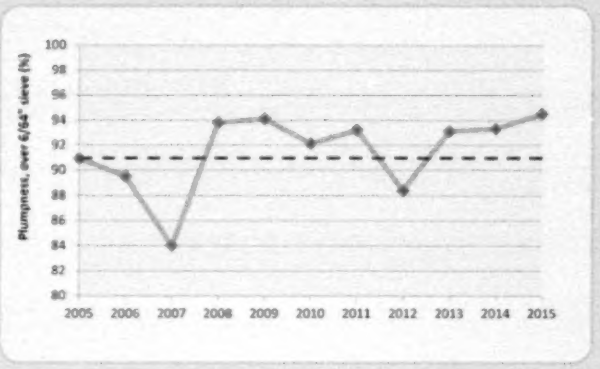
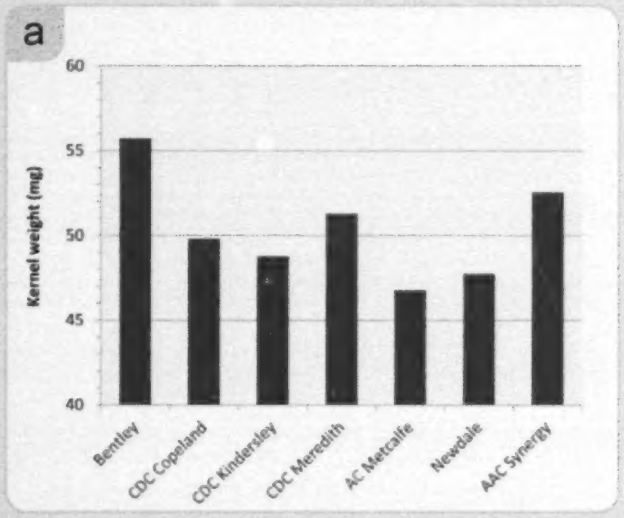
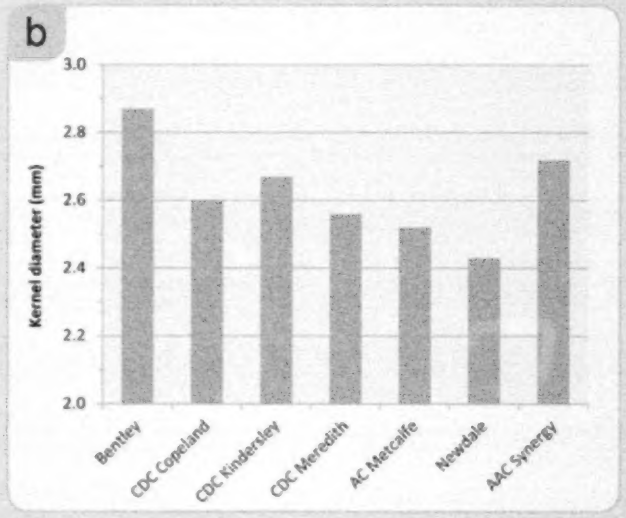


Figure 3.5 Variation in average kernel weight (a) and kernel diameter (b) among various two-rowed barley cultivars selected for malting in 2015. Kernel weight and diameter values were determined using Single Kernel Characterization System.

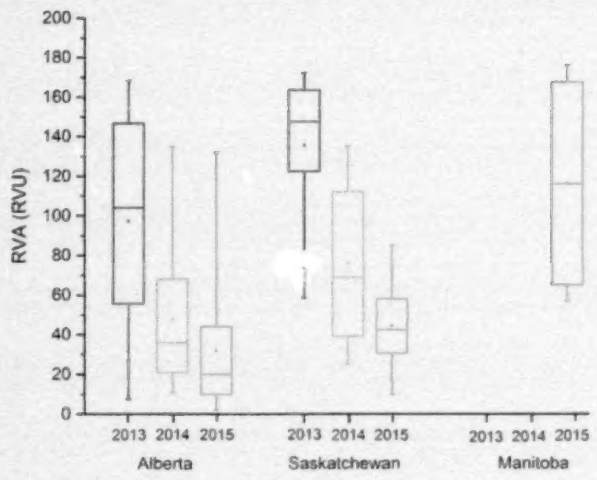




RVA is used by barley selectors to identify sound, moderately and strongly pre-germinated barley, and to manage their supply accordingly. Samples with final viscosity values > 120 (RVU) are considered sound and the probability that they will retain germination energy (GE) after storage is very high. Samples with RVA values 50-120 (RVU) are moderately pre-germinated, whereas samples with RVA values < 50 (RVU) are substantially pre-germinated and the probability that they will lose GE during storage is high. They should be malted as soon as possible. To predict safe storage time more accurately, not only the RVA values, but also the storage conditions (T and RH) and the initial moisture content of the grain have to be taken into account.

Among the samples tested in 2015 survey only a few showed high RVA values (>120 RVU). This year's RVA results have reflected wet harvest conditions, especially in Alberta and Saskatchewan, resulting in high incidence of substantial pre-germination (<50 RVU), similar to 2014, but dramatically different from dry harvest conditions in 2013 (Figure 3.6). The RVA results stress the need for identification of barley with low RVU that should be malted promptly. As indicated in the next sections of this report, pre-germinated barley malted soon after harvest can produce good quality malt.

Figure 3.6 RVA results for barley selected for malting in 2013, 2014, and 2015[1]



Risk of germination loss in storage	RVA Viscosity (RVU)
Low	≥120
Intermediate	50-120
High	<50

[1]The boxes in the graph shows the range of RVA values in the middle 50% of the analyzed samples; the horizontal line and the dot inside the box indicate the median and mean, respectively. The short horizontal lines outside of the box mark the minimum and maximum values.

3.3 Malting conditions and methodologies

Initial malting trials indicated that sufficient steep out moisture levels were achieved using two wet steep cycles. Despite slightly higher protein levels, kernels took up water easily with total wet steep time of 16 hours, similar to steep time in 2014. All analytical methods used in this survey to assess the barley, malt and wort quality are listed in the Appendix I.

Table 3.1 Malting conditions used with Phoenix Micromalting System in 2015

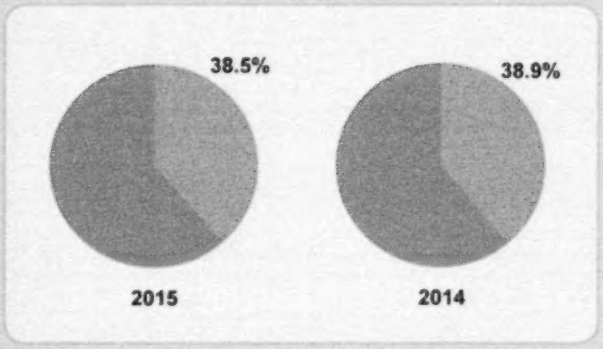
Steeping	8 hours wet steep, 16 hours air rest, 8 hours wet steep, 12 hours air rest @ 13°C
Germination	96 hours @ 15°C
Kilning	12 hours @ 60°C, 6 hours@ 65°C, 2 hours @ 75°C, 4 hours @ 85°C

3.4 Malting quality in 2015 - Highlights

- The quality of the 2015 barley crop was challenged by very dry conditions in spring and early summer and above average precipitation in August and September.
- Thousand kernel weights and kernel plumpness levels were higher than the long term averages.
- Protein levels in barley grain were higher than levels in 2014 and higher than the long term average values.
- Barley germination was adequate; however, some water sensitivity was present.
- RVA testing indicated high incidence of pre-harvest sprouting.
- Malt made from 2015 barley resulted in extract levels very close to the long term average values and higher than average levels of diastatic enzymes.
- Wort was characterized by very low levels of β-glucans, but higher than average levels of soluble proteins, free amino nitrogen (FAN), and colour.
- Production of good quality malt from the 2015 barley crop may pose some challenges but is achievable through discerning barley selection and timely and skillful processing.

AC Metcalfe

Figure 1. Percentage of the total malting barley acres in Western Canada seeded with AC Metcalfe in 2015 compared to 2014



AC Metcalfe continues to be the dominant malting barley variety grown in Western Canada. With high levels of extract and diastatic enzymes, its reputation for excellent brewing performance generates strong demand from both domestic and export markets.

Figure 2. Average protein content in AC Metcalfe selected for malting from 2010-2015

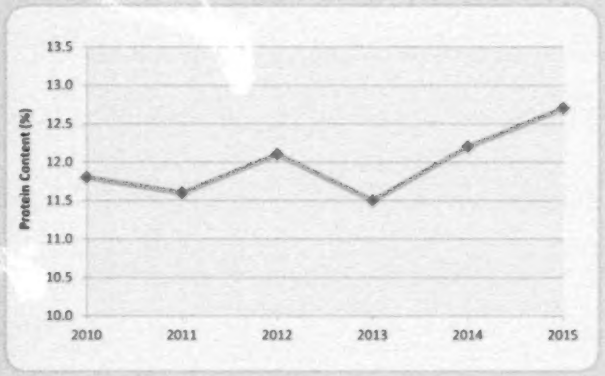


Figure 3. Average 1000 kernel weight of AC Metcalfe selected for malting from 2010-2015

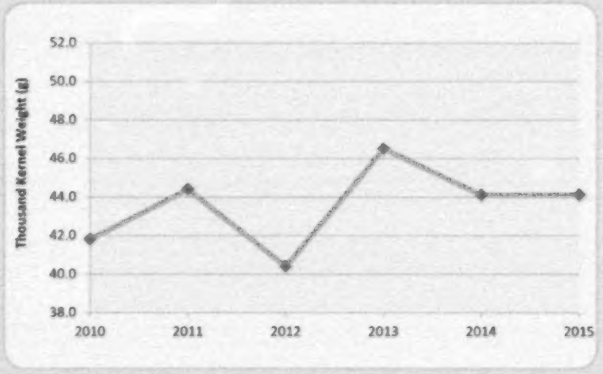


Figure 4. Comparison of average levels of extract by variety in 2015

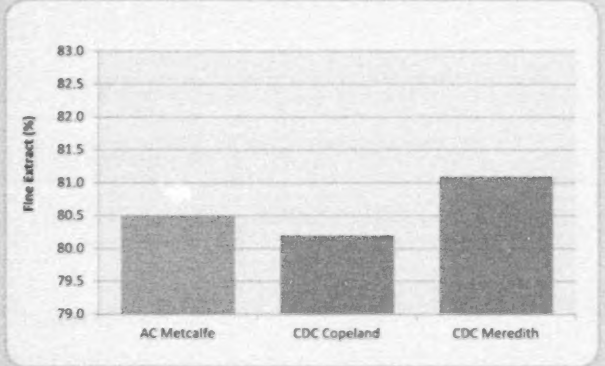


Figure 5. Comparison of average levels of diastatic power by variety in 2015

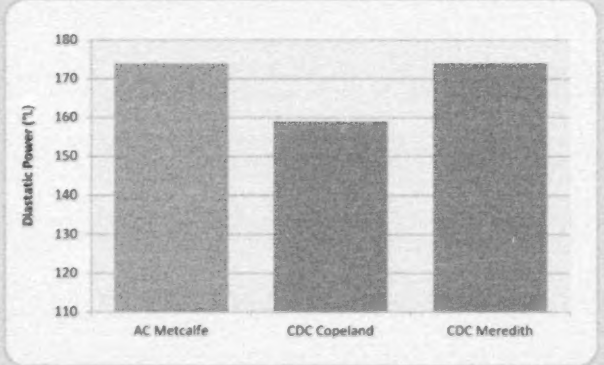


Table 3.2 Quality data for 2015 harvest survey composite samples of AC Metcalfe malting barley[1]

Origin of selected samples	Alberta		Saskatchewan		Prairie Provinces		
Crop year	2015	2014	2015	2014	2015	2014	2010-2014 Average
Tonnage[2], thousand of tonnes	247	172	198	155	445	327	319
Barley							
Test weight, kg/hL	67.7	67.1	67.2	65.9	67.5	66.5	67.1
1000 Kernel weight, g	44.7	44.8	43.5	43.5	44.1	44.1	43.4
Plump, over 6/64" sieve, %	93.4	94.0	92.8	91.8	93.1	92.9	91.9
Intermediate, over 5/64"sieve, %	4.9	4.6	5.5	6.2	5.2	5.4	6.1
Moisture[3], %	11.9	12.7	11.9	12.9	11.9	12.8	11.7
Protein, %	12.7	12.1	12.6	12.2	12.7	12.2	11.8
Germination, 4 ml (3 day), %	96	96	96	96	96	96	98
Germination, 8 ml (3 day), %	85	87	80	80	83	84	86
Malt							
Yield, %	90.2	90.7	89.7	90.3	90.0	90.5	91.7
Steep-out moisture, %	45.2	44.4	45.6	44.6	45.4	44.5	45.4
Friability, %	61.9	73.9	64.3	72.7	63.0	73.3	70.8
Moisture, %	5.2	4.8	5.1	4.9	5.2	4.9	5.2
Diastatic power, °L	175	168	173	171	174	170	165
α-Amylase, D.U.	74.8	78.9	75.0	79.0	74.9	79.0	70.5
Wort							
Fine grind extract, %	80.6	80.2	80.5	80.1	80.5	80.2	80.6
Coarse grind extract, %	79.8	79.4	79.8	79.5	79.8	79.4	79.8
F/C difference, %	0.8	0.7	0.6	0.7	0.7	0.7	0.6
ß-Glucan, ppm	40	77	34	70	38	73	76
Viscosity, cps	1.43	1.43	1.42	1.42	1.42	1.43	1.43
Soluble protein, %	5.16	5.02	5.39	5.35	5.26	5.18	4.87
Ratio S/T, %	41.7	41.5	43.8	44.0	42.6	42.7	40.8
FAN, mg/L	248	213	258	232	253	222	206
Colour, ASBC units	2.30	2.22	2.52	2.72	2.40	2.45	2.10

[1] Values represent weighted averages based on tonnage of composite samples received.

[2] Indicates weight of samples represented in this survey; does not represent amounts commercially selected.

[3] Moisture not representative of new crop moisture levels as samples were not collected or stored in moisture-proof containers.

CDC Copeland

CDC Copeland is the second largest two-rowed malting variety grown on the Prairies. Its excellent brewing characteristics combined with lower protein and enzyme levels, provides an excellent balance within the portfolio of malting barley varieties.

Figure 1. Percentage of the total malting barley acres in Western Canada seeded with CDC Copeland in 2015 compared to 2014

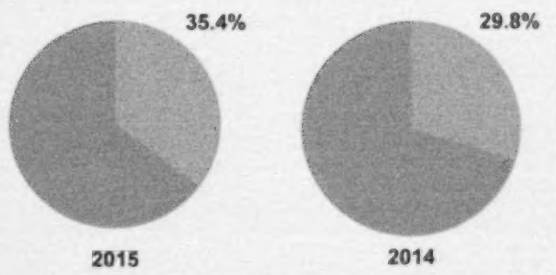


Figure 2. Average protein content in CDC Copeland selected for malting from 2010-2015

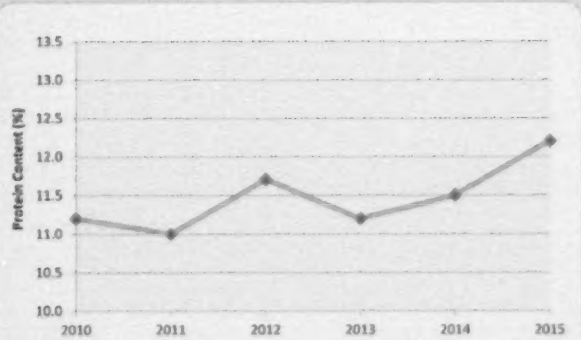


Figure 3. Average 1000 kernel weight of CDC Copeland selected for malting from 2010-2015

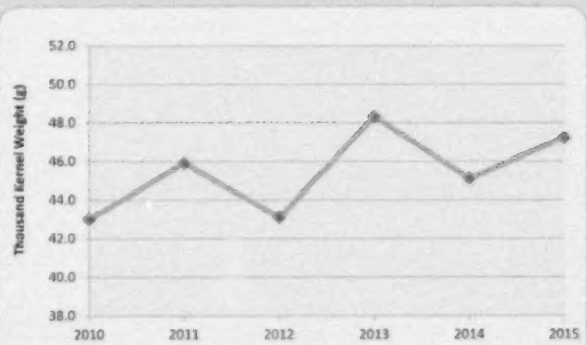


Figure 4. Comparison of average levels of extract by variety in 2015

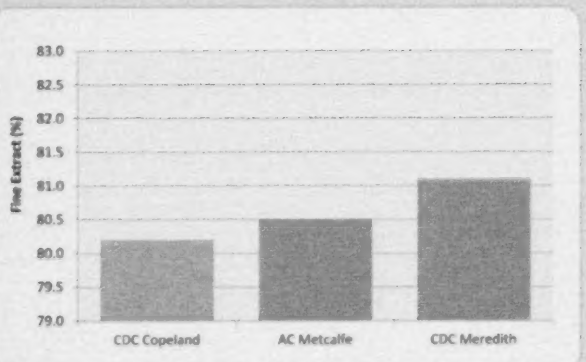


Figure 5. Comparison of average levels of diastatic power by variety in 2015

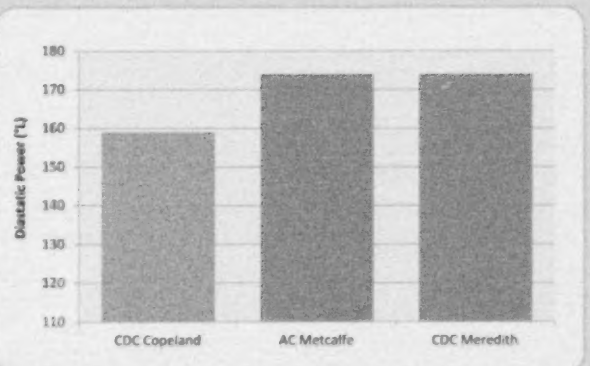


Table 3.3 Quality data for 2015 harvest survey composite samples of CDC Copeland malting barley[1]

Origin of selected samples	Alberta		Saskatchewan		Prairie Provinces		
Crop year	2015	2014	2015	2014	2015	2014	2010-2014 Average
Tonnage[2], thousand of tonnes	261	152	290	182	551	334	244
Barley							
Test weight, kg/hL	66.2	65.6	66.4	64.3	66.3	65.0	65.8
1000 Kernel weight, g	47.6	45.8	46.8	44.1	47.2	45.1	45.1
Plump, over 6/64" sieve, %	96.1	93.7	94.9	92.6	95.4	93.2	92.3
Intermediate, over 5/64"sieve, %	2.9	4.6	3.7	5.3	3.3	4.9	5.8
Moisture[3], %	12.1	12.8	12.7	13.4	12.4	13.1	11.9
Protein, %	12.2	11.5	12.3	11.5	12.2	11.5	11.3
Germination, 4 ml (3 day), %	97	96	97	93	97	94	97
Germination, 8 ml (3 day), %	94	88	86	83	90	85	90
Malt							
Yield, %	90.8	91.1	90.6	91.1	90.7	91.1	92.2
Steep-out moisture, %	44.9	44.6	45.3	45.0	45.1	44.8	45.1
Friability, %	73.9	79.8	74.6	81.0	74.2	80.3	78.7
Moisture, %	5.3	4.9	5.3	5.2	5.3	5.1	5.1
Diastatic power, °L	157	147	161	150	159	148	141
α-Amylase, D.U.	60.1	55.5	62.6	56.8	61.4	56.1	52.2
Wort							
Fine grind extract, %	80.2	80.2	80.3	80.4	80.2	80.3	80.5
Coarse grind extract, %	79.3	79.4	79.6	79.8	79.4	79.6	79.6
F/C difference, %	0.9	0.8	0.7	0.6	0.8	0.7	0.8
ß-Glucan, ppm	48	75	41	42	44	61	75
Viscosity, cps	1.43	1.43	1.43	1.41	1.43	1.42	1.43
Soluble protein, %	4.73	4.87	5.11	5.40	4.93	5.10	4.86
Ratio S/T, %	39.6	42.9	42.7	46.9	41.2	44.6	42.4
FAN, mg/L	217	200	234	238	226	216	199
Colour, ASBC units	2.06	2.22	2.31	3.04	2.19	2.58	2.21

[1] Values represent weighted averages based on tonnage of composite samples received.

[2] Indicates weight of samples represented in this survey; does not represent amounts commercially selected.

[3] Moisture not representative of new crop moisture levels as samples were not collected or stored in moisture-proof containers.

CDC Meredith

Figure 1. Percentage of the total malting barley acres in Western Canada seeded with CDC Meredith in 2015 compared to 2014

With its good agronomic and disease resistance, CDC Meredith has the potential to produce superior yields making it an attractive choice for producers. Good malting characteristics such as consistently lower protein, higher extracts and moderate levels of enzymes, translate into good overall brewing potential.

Figure 2. Average protein content in CDC Meredith selected for malting from 2010-2015

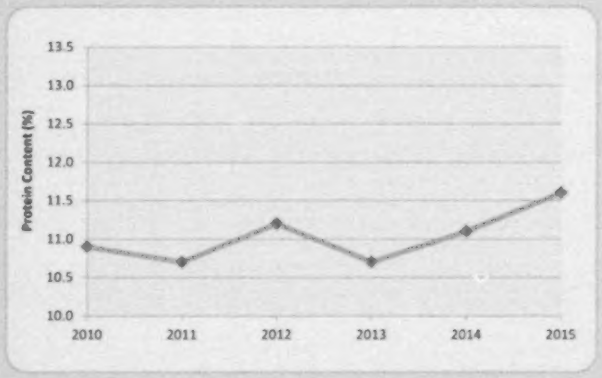


Figure 3. Average 1000 kernel weight of CDC Meredith selected for malting from 2010-2015

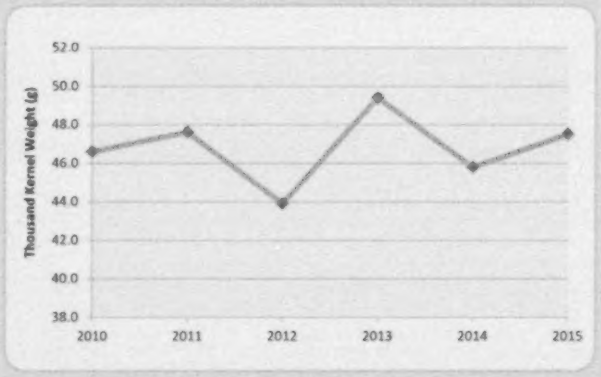


Figure 4. Comparison of average levels of extract by variety in 2015

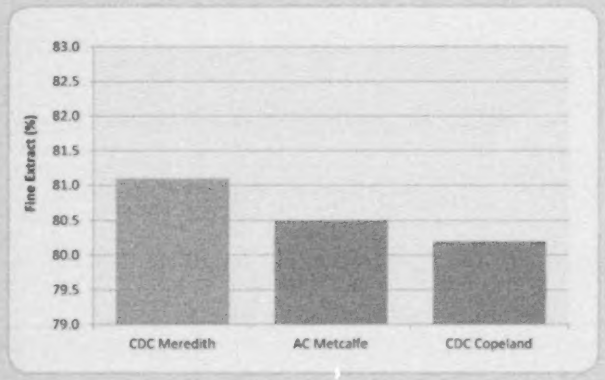


Figure 5. Comparison of average levels of diastatic power by variety in 2015

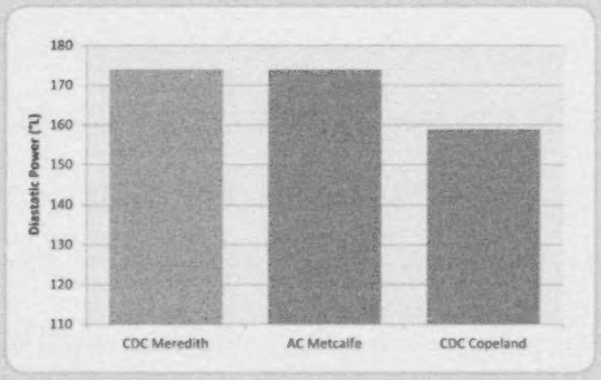


Table 3.4 Quality data for 2015 harvest survey composite samples of CDC Meredith malting barley[1]

Origin of selected samples	Alberta		Saskatchewan		Prairie Provinces		
Crop year	2015	2014	2015	2014	2015	2014	2010-2014 Average
Tonnage[2], thousand of tonnes	13.3	45	9.3	4	22.6	49	55.6
Barley							
Test weight, kg/hL	65.0	64.1	64.0	68.8	64.6	64.6	65.9
1000 Kernel weight, g	48.4	45.7	46.2	47.2	47.5	45.8	46.7
Plump, over 6/64" sieve, %	95.1	95.2	94.2	94.8	94.7	95.2	94.6
Intermediate, over 5/64"sieve, %	3.6	3.4	4.4	3.5	3.9	3.4	3.9
Moisture[3], %	12.3	12.5	11.8	9.9	12.1	12.2	12.4
Protein, %	11.6	11.2	11.6	10.5	11.6	11.1	10.9
Germination, 4 ml (3 day), %	98	89	99	98	98	90	96
Germination, 8 ml (3 day), %	90	76	91	87	91	77	87
Malt							
Yield, %	89.5	89.9	89.1	89.1	89.4	89.8	91.1
Steep-out moisture, %	46.3	46.5	46.8	44.1	46.5	46.3	46.5
Friability, %	77.8	83.4	80.3	82.0	78.8	83.2	81.5
Moisture, %	5.6	5.1	5.6	5.0	5.6	5.1	5.1
Diastatic power, °L	172	155	176	143	174	153	153
α-Amylase, D.U.	65.8	62.5	71.4	67.0	68.1	62.9	59.8
Wort							
Fine grind extract, %	81.1	81.0	81.0	82.8	81.1	81.2	81.3
Coarse grind extract, %	80.5	80.3	80.1	82.0	80.4	80.4	80.4
F/C difference, %	0.6	0.7	0.9	0.8	0.7	0.7	0.8
ß-Glucan, ppm	51	114	44	167	48	119	99
Viscosity, cps	1.44	1.43	1.43	1.46	1.44	1.44	1.42
Soluble protein, %	4.95	4.73	5.06	4.46	4.99	4.70	4.78
Ratio S/T, %	44.8	43.7	45.5	46.0	45.1	43.9	43.9
FAN, mg/L	234	209	236	198	235	208	201
Colour, ASBC units	2.36	2.56	2.48	2.37	2.41	2.54	2.37

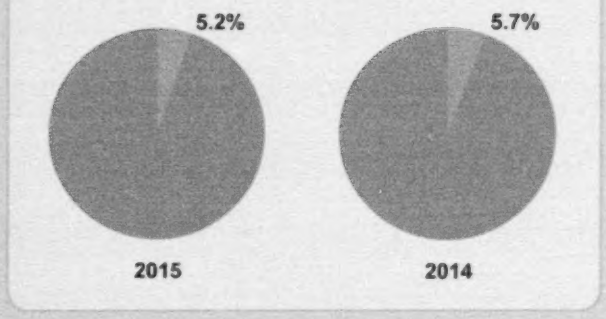
[1] Values represent weighted averages based on tonnage of composite samples received.

[2] Indicates weight of samples represented in this survey; does not represent amounts commercially selected.

[3] Moisture not representative of new crop moisture levels as samples were not collected or stored in moisture-proof containers.

Newdale

Figure 1. Percentage of the total malting barley acres in Western Canada seeded with Newdale in 2015 compared to 2014



Newdale continues to represent a small but consistent share of barley selected for malting each year. With good friability and low levels of β-glucans, it performs well in the brewhouse. Its moderate levels of enzymes, soluble proteins and FAN make Newdale well-suited for all-malt brewing.

Figure 2. Average protein content in Newdale selected for malting from 2010-2015

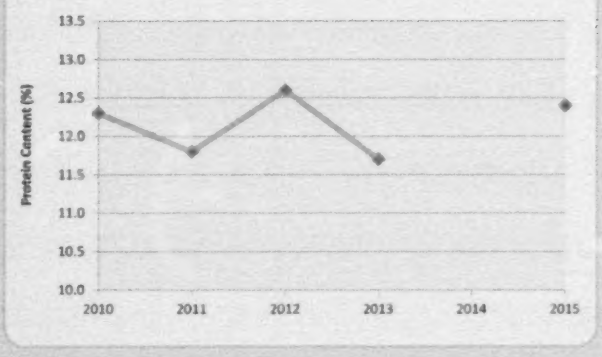


Figure 3. Average 1000 kernel weight of Newdale selected for malting from 2010-2015

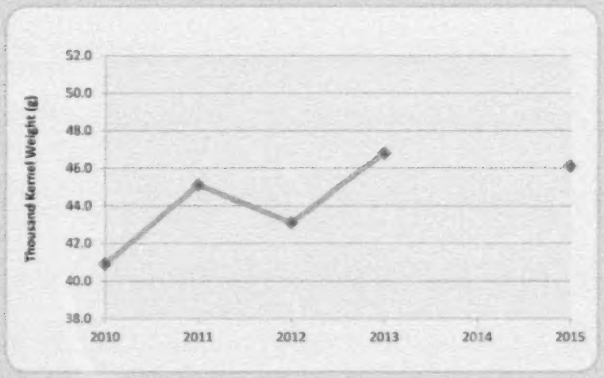


Figure 4. Comparison of average levels of extract by variety in 2015

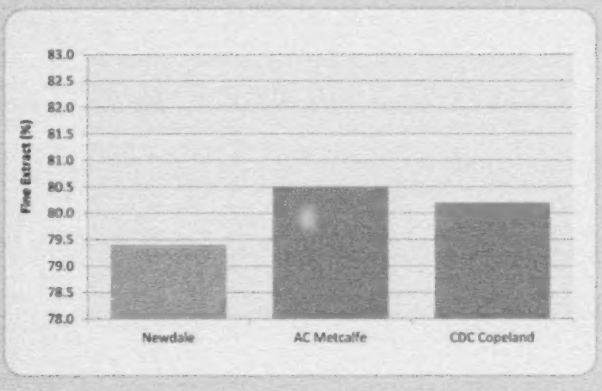


Figure 5. Comparison of average levels of diastatic power by variety in 2015

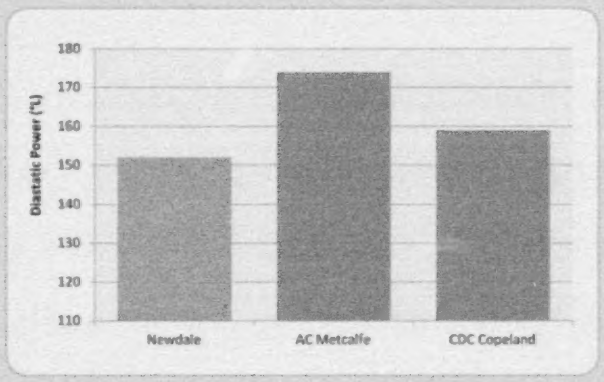


Table 3.5 Quality data for 2015 harvest survey composite samples of Newdale malting barley[1]

Origin of selected samples	Prairie Provinces		
Crop year[2]	2015	2013	2010-2013 Average
Tonnage[3], thousand of tonnes	14	37	17
Barley			
Test weight, kg/hL	65.1	66.4	64.8
1000 Kernel weight, g	46.1	46.8	44.0
Plump, over 6/64" sieve, %	96.1	93.2	90.1
Intermediate, over 5/64"sieve, %	2.8	5.4	7.5
Moisture[4], %	14.0	11.5	12.9
Protein, %	12.4	11.7	12.1
Germination, 4 ml (3 day), %	96	99	99
Germination, 8 ml (3 day), %	88	91	90
Malt			
Yield, %	91.0	89.8	91.9
Steep-out moisture, %	45.5	45.0	46.3
Friability, %	72.6	83.0	78.4
Moisture, %	5.5	4.9	5.1
Diastatic power, °L	152	139	146
α-Amylase, D.U.	61.1	67.6	61.7
Wort			
Fine grind extract, %	79.4	80.9	79.6
Coarse grind extract, %	78.4	80.2	79.1
F/C difference, %	1.0	0.6	0.5
ß-Glucan, ppm	46	43	59
Viscosity, cps	1.43	1.42	1.40
Soluble protein, %	4.58	4.71	4.80
Ratio S/T, %	38.4	40.5	39.6
FAN, mg/L	194	185	180
Colour, ASBC units	2.08	1.87	1.89

[1] Values represent weighted averages based on tonnage of composite samples received.

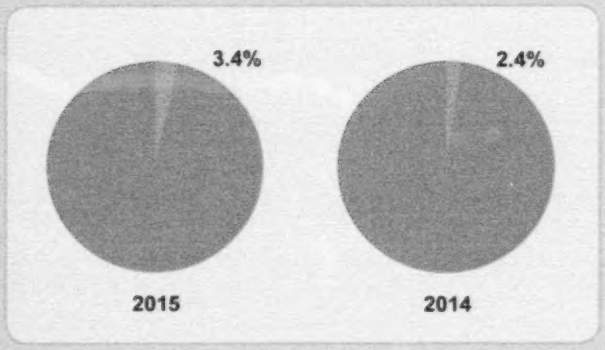
[2] Newdale not included in 2014 Harvest Survey due to lack of sufficient number of samples.

[3] Indicates weight of samples represented in this survey; does not represent amounts commercially selected.

[4] Moisture not representative of new crop moisture levels as samples were not collected or stored in moisture-proof containers.

Bentley

Figure 1. Percentage of the total malting barley acres in Western Canada seeded with Bentley in 2015 compared to 2014



Significant quantities of Bentley barley were grown and selected in 2015. The production of Bentley has continued to increase every year since 2011. With high yields and good disease resistance, Bentley is an attractive choice for producers. Bentley's consistently large kernels have the potential to deliver high levels of extract.

Figure 2. Average protein content in Bentley selected for malting from 2010-2015

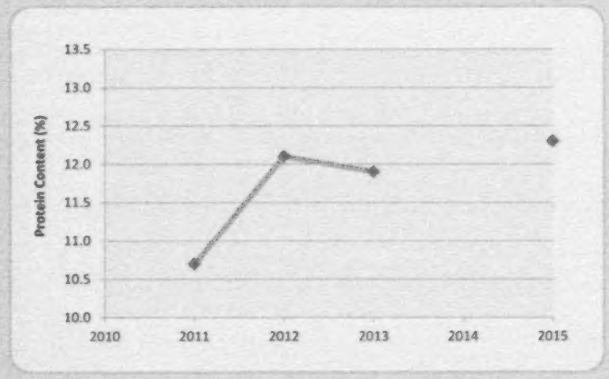


Figure 3. Average 1000 kernel weight of Bentley selected for malting from 2010-2015

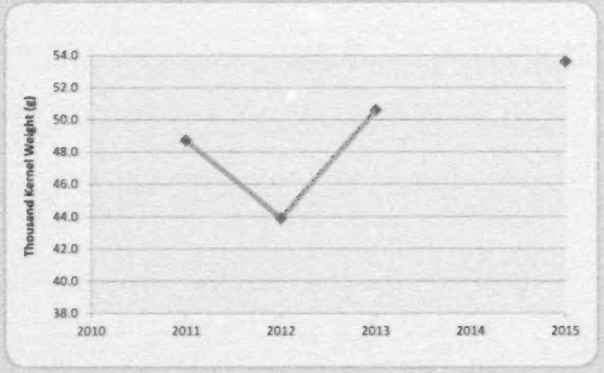


Figure 4. Comparison of average levels of extract by variety in 2015

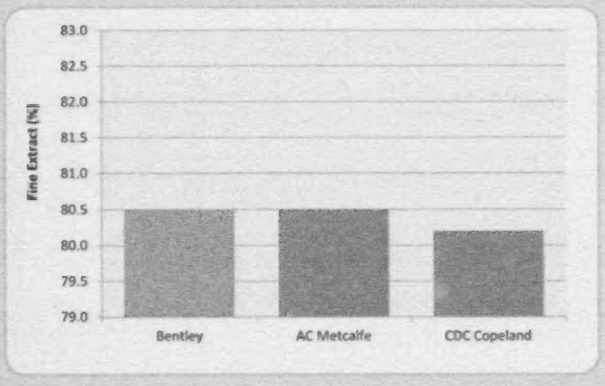


Figure 5. Comparison of average levels of diastatic power by variety in 2015

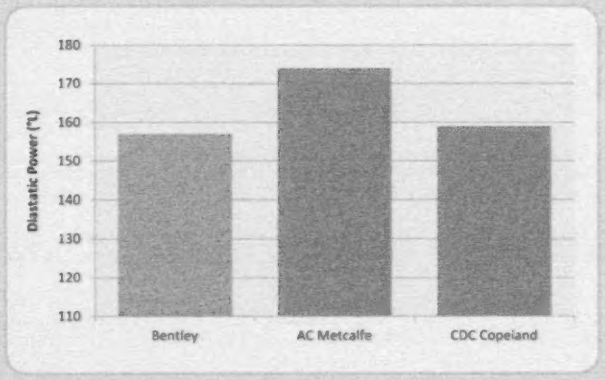


Table 3.6 Quality data for 2015 harvest survey composite samples of Bentley malting barley[1]

Origin of selected samples	Prairie Provinces		
Crop year[2]	2015	2013	2010-2013 Average
Tonnage[3], thousand of tonnes	6.3	9	6
Barley			
Test weight, kg/hL	64.5	66.7	63.6
1000 Kernel weight, g	53.6	50.6	47.3
Plump, over 6/64" sieve, %	96.7	95.8	92.1
Intermediate, over 5/64"sieve, %	1.5	2.9	5.4
Moisture[4], %	14.0	12.4	13.2
Protein, %	12.3	11.9	12.0
Germination, 4 ml (3 day), %	94	99	99
Germination, 8 ml (3 day), %	82	80	79
Malt			
Yield, %	91.0	89.5	90.0
Steep-out moisture, %	45.8	45.3	46.0
Friability, %	60.5	78.3	76.9
Moisture, %	5.7	5.0	5.3
Diastatic power, °L	157	148	153
α-Amylase, D.U.	51.1	61.0	62.1
Wort			
Fine grind extract, %	80.5	81.5	80.7
Coarse grind extract, %	80.2	80.8	80.2
F/C difference, %	0.3	0.7	0.5
ß-Glucan, ppm	41	41	43
Viscosity, cps	1.44	1.43	1.42
Soluble protein, %	5.11	5.06	5.03
Ratio S/T, %	42.0	42.5	42.3
FAN, mg/L	244	224	226
Colour, ASBC units	2.35	2.31	2.43

[1] Values represent weighted averages based on tonnage of composite samples received.

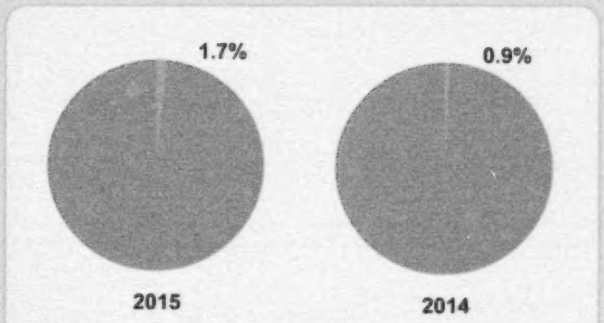
[2] Bentley not included in 2014 Harvest Survey due to lack of sufficient number of samples.

[3] Indicates weight of samples represented in this survey; does not represent amounts commercially selected.

[4] Moisture not representative of new crop moisture levels as samples were not collected or stored in moisture-proof containers.

CDC Kindersley

Figure 1. Percentage of the total malting barley acres in Western Canada seeded with CDC Kindersley in 2015 compared to 2014



CDC Kindersley is a newer early maturing, high yielding variety descended from CDC Kendall. CDC Kindersley modifies easily, resulting in high friability values and low levels of wort β-glucan. Its relatively high FAN and enzyme levels make it well suited for adjunct or high gravity brewing.

Figure 2. Average protein content in CDC Kindersley selected for malting from 2010-2015

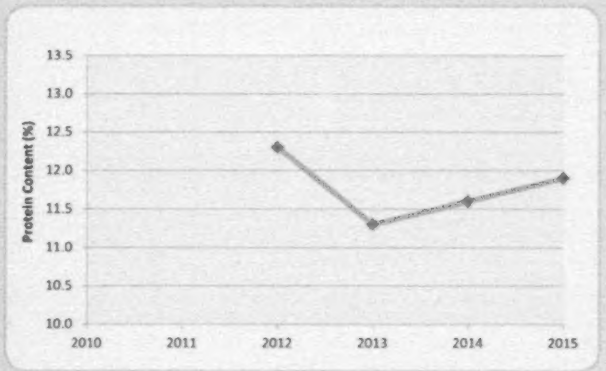


Figure 3. Average 1000 kernel weight of CDC Kindersley selected for malting from 2010-2015

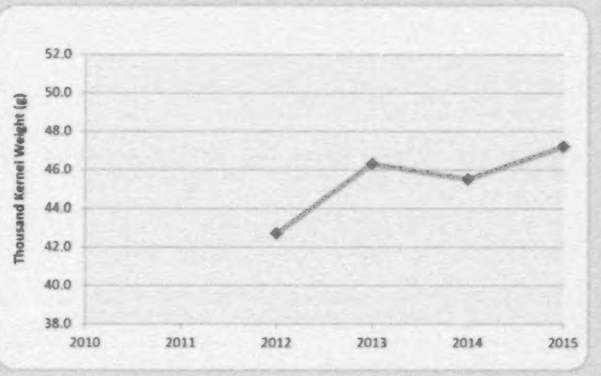


Figure 4. Comparison of average levels of extract by variety in 2015

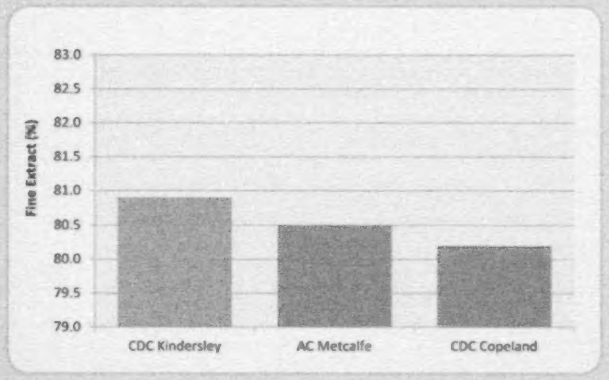


Figure 5. Comparison of average levels of diastatic power by variety in 2015

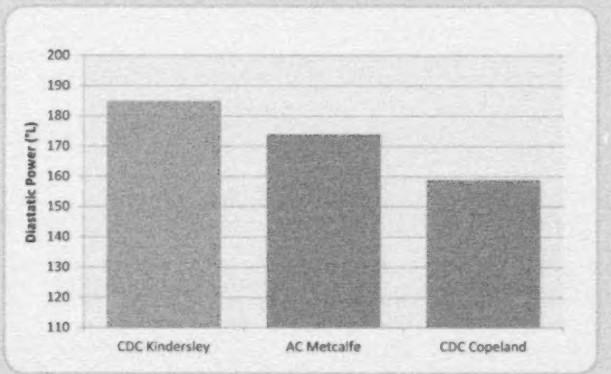


Table 3.7 Quality data for 2015 harvest survey composite samples of CDC Kindersley malting barley[1]

Origin of selected samples	Prairie Provinces		
Crop year	2015	2014	2012-2014 Average
Tonnage[2], thousand of tonnes	4.2	17	9
Barley			
Test weight, kg/hL	66.5	64.9	67.1
1000 Kernel weight, g	47.2	45.5	44.8
Plump, over 6/64" sieve, %	96.7	94.7	92.8
Intermediate, over 5/64"sieve, %	2.2	3.7	5.1
Moisture[3], %	13.4	13.1	12.5
Protein, %	11.9	11.6	11.7
Germination, 4 ml (3 day), %	94	94	97
Germination, 8 ml (3 day), %	82	84	91
Malt			
Yield, %	90.5	89.7	90.3
Steep-out moisture, %	46.6	46.5	45.7
Friability, %	66.8	77.8	76.5
Moisture, %	5.6	5.4	5.2
Diastatic power, °L	185	180	186
α-Amylase, D.U.	57.4	68.7	68.4
Wort			
Fine grind extract, %	80.9	80.5	80.6
Coarse grind extract, %	80.6	79.7	80.1
F/C difference, %	0.4	0.8	0.6
ß-Glucan, ppm	24	59	44
Viscosity, cps	1.43	1.41	1.40
Soluble protein, %	5.58	4.93	5.18
Ratio S/T, %	46.2	43.3	44.2
FAN, mg/L	269	207	217
Colour, ASBC units	2.81	2.29	2.33

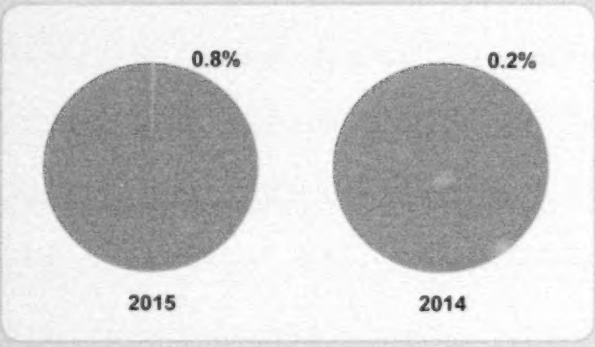
[1] Values represent weighted averages based on tonnage of composite samples received.

[2] Indicates weight of samples represented in this survey; does not represent amounts commercially selected.

[3] Moisture not representative of new crop moisture levels as samples were not collected or stored in moisture-proof containers.

AAC Synergy

Figure 1. Percentage of the total malting barley acres in Western Canada seeded with AAC Synergy in 2015 compared to 2014



The quality data for AAC Synergy appear in this report for the first time. AAC Synergy is a newer high yielding variety with relatively high kernel weight and plumpness. AAC Synergy is characterized by relatively low grain protein content. AAC Synergy has a desirable malting quality profile with high malt extract, good protein modification, low levels of wort beta-glucans, and intermediate levels of starch-degrading enzymes. Overall, AAC Synergy's excellent combination of agronomic traits, disease resistance and malting quality make it a desirable two-rowed malting barley variety for western Canadian producers and the malting and brewing industry.

Figure 2. Average protein content in AAC Synergy selected for malting in 2015

Figure 3. Average 1000 kernel weight of AAC Synergy selected for malting in 2015

Figure 4. Comparison of average levels of extract by variety in 2015

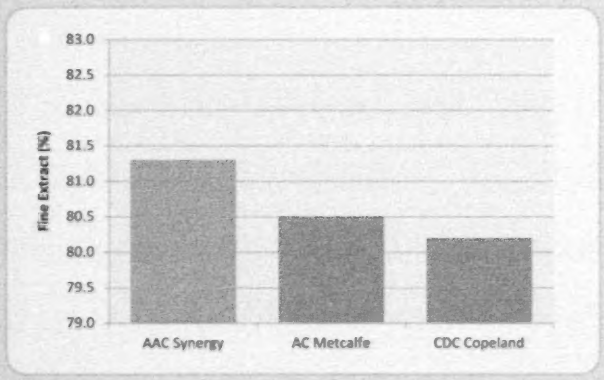


Figure 5. Comparison of average levels of diastatic power by variety in 2015

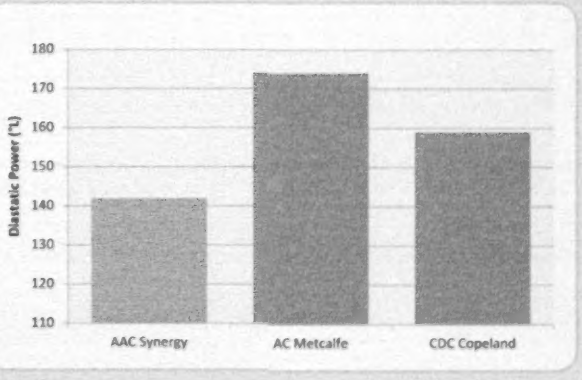


Table 3.8 Quality data for 2015 harvest survey composite samples of AAC Synergy malting barley[1]

Origin of selected samples	Prairie Provinces
Crop year	2015
Tonnage[2], thousand of tonnes	8.1
Barley	
Test weight, kg/hL	66.7
1000 Kernel weight, g	51.4
Plump, over 6/64" sieve, %	97.2
Intermediate, over 5/64"sieve, %	1.6
Moisture[3], %	12.6
Protein, %	11.5
Germination, 4 ml (3 day), %	99
Germination, 8 ml (3 day), %	95
Malt	
Yield, %	90.5
Steep-out moisture, %	45.4
Friability, %	72.4
Moisture, %	5.2
Diastatic power, °L	142
α-Amylase, D.U.	65.4
Wort	
Fine grind extract, %	81.3
Coarse grind extract, %	80.3
F/C difference, %	1.0
ß-Glucan, ppm	25
Viscosity, cps	1.41
Soluble protein, %	4.58
Ratio S/T, %	42.0
FAN, mg/L	212
Colour, ASBC units	1.96

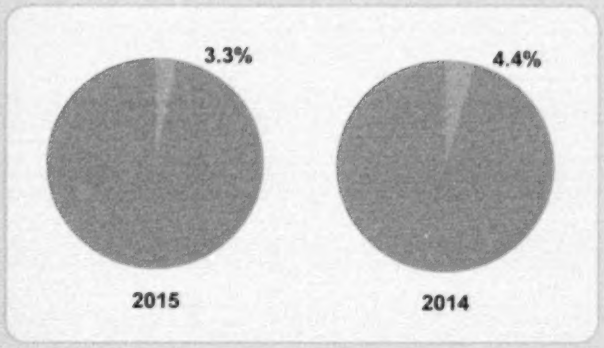
[1] Values represent weighted averages based on tonnage of composite samples received.

[2] Indicates weight of samples represented in this survey; does not represent amounts commercially selected.

[3] Moisture not representative of new crop moisture levels as samples were not collected or stored in moisture-proof containers.

Legacy

Figure 1. Percentage of the total malting barley acres in Western Canada seeded with Legacy in 2015 compared to 2014



While acres planted to six-rowed malting barley are in decline, small amounts of Legacy barley continue to be grown and selected. Legacy's high enzyme package makes it ideal for high gravity or adjunct brewing.

Figure 2. Average protein content in Legacy selected for malting from 2010-2015

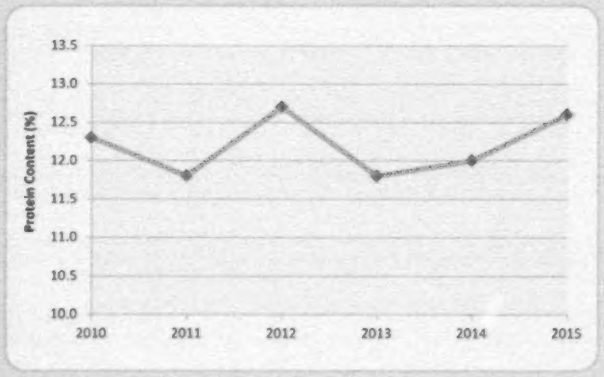


Figure 3. Average 1000 kernel weight of Legacy selected for malting from 2010-2015

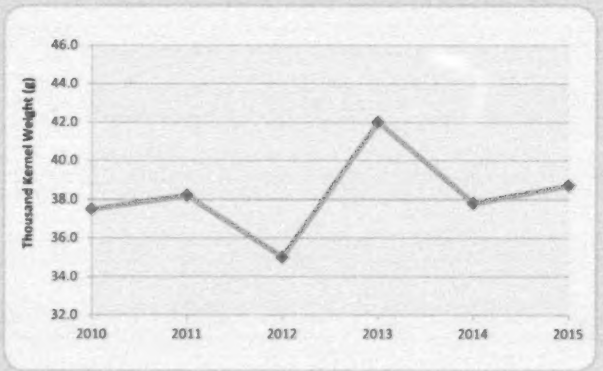


Figure 4. Comparison of average levels of extract by variety in 2015

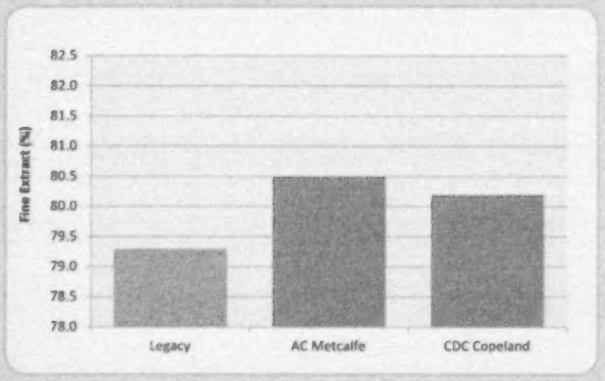


Figure 5. Comparison of average levels of diastatic power by variety in 2015

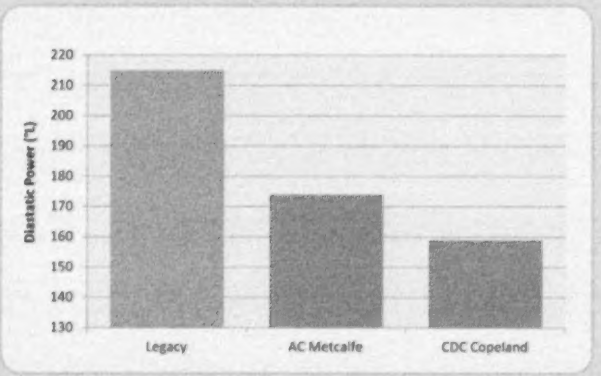


Table 3.9 Quality data for 2015 harvest survey composite samples of Legacy malting barley[1]

Origin of selected samples	Prairie Provinces		
Crop year	2015	2014	2010-2014 Average
Tonnage[2], thousand of tonnes	45	48	36
Barley			
Test weight, kg/hL	63.9	64.5	64.5
1000 Kernel weight, g	38.7	37.9	38.1
Plump, over 6/64" sieve, %	94.1	93.5	92.5
Intermediate, over 5/64"sieve, %	4.6	4.9	5.3
Moisture[3], %	11.4	9.9	11.2
Protein, %	12.6	12.0	12.1
Germination, 4 ml (3 day), %	100	93	95
Germination, 8 ml (3 day), %	79	73	76
Malt			
Yield, %	91.1	91.1	92.2
Steep-out moisture, %	44.8	43.3	45.2
Friability, %	72.1	72.0	71.4
Moisture, %	5.8	5.1	5.2
Diastatic power, °L	215	173	183
α-Amylase, D.U.	73.8	69.8	62.0
Wort			
Fine grind extract, %	79.3	79.9	79.4
Coarse grind extract, %	78.2	78.8	78.2
F/C difference, %	1.1	1.1	0.9
ß-Glucan, ppm	173	296	204
Viscosity, cps	1.43	1.47	1.45
Soluble protein, %	5.28	5.49	5.40
Ratio S/T, %	43.7	47.9	44.7
FAN, mg/L	250	240	233
Colour, ASBC units	1.99	2.39	2.42

[1] Values represent weighted averages based on tonnage of composite samples received.

[2] Indicates weight of samples represented in this survey; does not represent amounts commercially selected.

[3] Moisture not representative of new crop moisture levels as samples were not collected or stored in moisture-proof containers.

Appendix I - Methods

This section describes methods used at the Grain Research Laboratory. Unless otherwise specified, analytical results for barley and malt are reported on a dry weight basis.

α-Amylase activity

α-Amylase activity is determined according to ASBC method MALT 7B by segmented flow analysis, using ASBC dextrinized starch as the substrate, and calibrated with standards that have been determined by method ASBC Malt 7A.

Assortment

All samples are passed through a Carter Dockage Tester equipped with a No. 6 riddle to remove foreign material and two slotted sieves to sort the barley. plump barley is the material retained on a 6/64" (2.38 mm) x 3/4" slotted sieve.

Intermediate Grade is barley that passes through the 6/64" x 3/4" sieve but is retained on a 5/64" (1.98 mm) x 3/4" slotted sieve.

β-Glucan content

β-Glucan content is determined in malt extract by segmented flow analysis using Calcofluor staining of soluble, high molecular weight ß-glucan (ASBC Wort-18B).

Diastatic power

Diastatic power is determined by segemented flow analysis, using an automated neocuproin assay for reducing sugars, which is calibrated using malt standards analysed using the official ferricyanide reducing sugar method, (ASBC Malt 6A).

Fine-grind and coarse-grind extracts

Extracts are prepared using an Industrial Equipment Corporation (IEC) mash bath and the Congress mashing procedure from 45°C to 70°C. Specific gravities are determined at 20°C with an Anton Paar DMA 5000M digital density meter (ASBC Malt-4).

Free Amino Nitrogen (FAN)

Free amino nitrogen is determined on the fine extract according to the official ASBC method Wort-12 by segmented flow analysis.

Germination energy

Germination energy is determined by placing 100 kernels of barley on two layers of Whatman #1 filter paper, in a 9.0 cm diameter petri dish, and adding 4.0 ml of purified water. Samples are controlled at 20 degrees Celcius and 90% relative humidity in a germination chamber. Germinated kernels are removed after 24 and 48 hours and a final count is made at 72 hours (ASBC Barley 3C).

Kolbach index (ratio S/T)

Kolbach index is calculated from the formula, (% Soluble protein/% Malt protein) x 100.

Micromalting

Malts are prepared using an Automated Phoenix Micromalting System designed to handle twenty-four 500 g samples of barley per batch.

Malt mills

Fine-grind malt is prepared with a Buhler-Miag disc mill set to fine-grind. Coarse-grind malt is prepared with the same mill set to coarse-grind. The settings for fine- and coarse-grinds are calibrated quarterly, based on the screening of a ground ASBC standard check malt (ASBC Malt-4).

Moisture content of barley

Moisture content of barley is predicted using NIR equipment that has been calibrated by the standard ASBC method (ASBC Barley 5C).

Moisture content of malt

Moisture content of malt is determined on a ground sample by oven drying at 104°C for 3 hours (ASBC Malt-3).

Protein content (N x 6.25)

Protein content is predicted on dockage-free barley using NIR equipment that has been calibrated by Combustion Nitrogen Analysis (CNA). CNA is determined on a LECO Model FP-428 CNA analyser calibrated by EDTA. Samples are ground on a UDY Cyclone Sample Mill fitted with a 1.0-mm screen. A 200-mg sample is analysed as received (it is not dried prior to analysis). A moisture analysis is also performed and results are reported on a dry matter basis (ASBC Barley 7C).

Rapid Viscometric Analysis

The degree of pre-germination in barley was determined as described by Izydorczyk (2005); see the CGC website at http://www.grainscanada.gc.ca/research-recherche/izydorczyk/rva/rva-eng.htm. Samples were analyzed using the RVA-4 (Newport Scientific) and the Stirring Number Program. Final viscosity values were presented in Rapid Visco Units (RVU).

Viscosity

Viscosity is measured on fine grind Congress wort using an Anton Paar Lovis 2000 automated rolling ball viscometer (ASBC Wort-13B).

Water sensitivity

Water sensitivity is determined exactly as described for germination energy, except that 8.0 ml of purified water is added to each petri dish (ASBC 3C, IOB and EBC procedure). The water sensitivity value is the numerical difference between the 4ml and 8ml tests.

Weight per thousand kernels

A 500 gram sample of dockage-free barley is divided several times in a mechanical divider to obtain one representative 40g sub-sample. All foreign material and broken kernels are removed from one 40 gram portion and the net weight determined. The number of kernels is then counted with a mechanical counter and thousand kernel weight is calculated (as is basis) (Institute of Brewing's Recommended Methods of Analysis, Barley 1.3 (1997)).

Wort-soluble protein

Wort-soluble protein is determined spectrophotometrically using ASBC method Wort-17.

Acknowledgments

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